REMARKS

The Official Action of 19 September 2007 has been carefully considered and reconsideration of the application as amended is respectfully requested.

The specification has been amended to identify the nucleotide sequences described therein with SEQ ID NOs as required in paragraph 2 of the Official Action. A revised Sequence Listing is submitted herewith, along with the requisite statements of identity and no new matter, to identify the sequences in Figs. 4 and 5 that were not previously included in the Sequence Listing. Applicants respectfully note that the sequence rules only apply to unbranched sequences of ten (10) or more nucleotides (see MPEP 2422).

The claims have been amended to reinstate the definition of storage DNA in original claim 1 and thereby to remove the basis for the rejection under 35 USC 112, second paragraph appearing at paragraph 4 of the Official Action.

Claims 1, 2, 4, 5, 11, 13 ,17, 22, 26, 27 and 29-31 were rejected under 35 USC 103(a) as allegedly being unpatentable over Bancroft et al in view of Ackley. Applicants respectfully traverse this rejection.

The claimed invention is based in part upon Applicants' recognition that a secret message can be encoded in a DNA sequence wherein each character of an extended 256 ASCII character set is represented by a code of 4 DNA bases

(see Fig. 3 of the drawings). Applicants also recognized that, since such an extended ASCII character set can be represented by a combination of 4 bases (4^n = 256 combinations, where n=4 bases), there is no need for a higher combination of bases for each ASCII character. This is advantageous since, if more than 4 bases were used, handling of codes would no longer be a simple task.

In contrast, Bancroft et al teaches encryption of 40 characters, 26 capital alphabets (no information regarding smaller counterparts), 10-numerals (i.e. 0-9 numbers) and four special characters (space, comma, dot, colon). It does not disclose or teach encryption of <u>256 standard ASCII characters.</u>

Bancroft et al teachings are limited to <u>alpha-numerals and certain special characters and can not represent most of the digital documents like images/audio/video</u> etc. The claimed method for storing information using a unique sequence of <u>four DNA bases</u> can be used to encrypt text images, video, audio and every kind of digital information.

The Examiner has acknowledged that Bancroft does not teach the provision of an encryption key where each character of an extended ASCII character set is represented by a DNA code of four bases, but he contends that it would have been obvious from Ackley to increase the number of DNA bases representing each character because Ackley teaches that increasing the size of a code increases the number of characters the code may represent. However,

Ackley does not show or suggest the use of 4 (and only 4) unique **DNA bases** to represent 256 ASCII characters nor does he consider the difficulties that are presented in the use of lengthy DNA bases for encryption. Thus, the portion of Ackley that the Examiner cites for the rejection (columns 1 and 2) describe only 7-bit character sets and higher. (In the summary of his invention, Ackley uses a 6-bit character set.)

Accordingly, Ackley not only does not provide a motivation, reason or rationale to use a character set comprising DNA bases, it also does not provide a motivation, reason or rationale to use 4 and only 4 DNA bases to represent 256 ASCII characters. This is particularly true because DNA bases are naturally read in triplets, as is the case in Bancroft (see Bancroft at Fig. 1 B). There is nothing in either Ackley or Bancroft that would cause one of skill in the art to overcome the prejudice of reading DNA bases as they are read naturally, in triplets. If there were, Bancroft would not have used a triplet code since it was filed long after the publication of the earliest of the applications in the storing of Ackley applications.

Another example of the failure of others to solve the problem solved by Applicants is the work on DNA encryption, reported by Smith et al, 2003, "Some possible codes for encrypting data in DNA", Biotech. Lett. 25: 1125-1130. Smith et al proposed three DNA encryption methods and used up to 6 DNA bases per character and could address only alphabets and some additional characters. Thus, Smith et al too failed to recognize what is required to represent all kind of digital information (e.g. text, images, audio, video etc.) in terms of DNA bases.

Table 1. General features of Smith et al.'s work on DNA encryption

Code	Codon (size/bases)	Number of codons
Huffman	1-5	26
Comma	6	80
Alternating	6	64

In short, as evidenced by the failure of others to arrive at the claimed invention, using a unique sequence of 4-DNA bases per character to encrypt a complete extended ASCII character set, thereby describing encryption of all kind of digital information e.g. text, images, audio, video etc., is novel and non-obvious. This failure is also evidenced by: (i) Bankcroft et al (US 6,321,911) have not claimed to encrypt any ASCII character; and (ii) Bankcroft et al (US 6,321,911) have claimed to encrypt a total of 40 characters only: 26-aplhabets (capitals only), 10-numerals (i.e. 0-9 numbers) and four special characters (space, comma, dot, colon). Also, even assuming *arguendo* that Bankcroft et al method were meant for digital information (which it is not), <u>it is limited to alpha-numerals and certain special characters and can not represent most digital documents, including, images/audio/video</u>, etc.

For the above reasons, Applicants respectfully submit that it would not have been obvious from Bancroft, Ackley or their combination to increase the number of nucleotides in the base code of Bancroft to four (4), as required in all of the claims presently of record. With particular respect to claim 22 and the claims depending therefrom, Applicants respectfully note that these claims

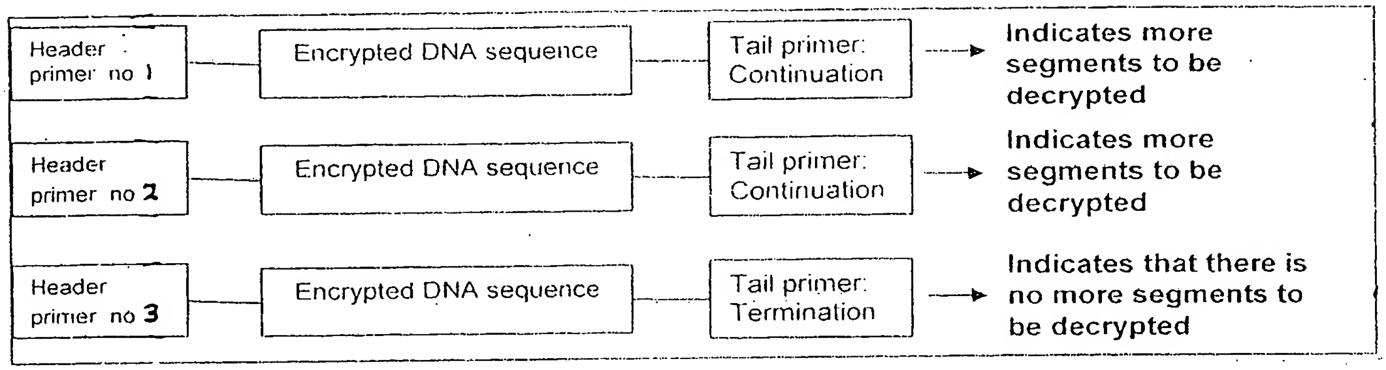
require that the encryption sequence of each of a plurality of DNA molecules encodes a different portion of a message. There is nothing in either of the references to show this and Applicants respectfully submit that these claims are separately patentable for this reason as well.

The Examiner has referred to Bancroft at column 4, lines 45-54 and column 6, lines 30-42 as allegedly teaching the production of a plurality of synthetic DNA molecules that each encodes a different portion of a message, but Applicants respectfully disagree. At column 4, lines 45-54, Bancroft teaches that the DNA molecules may differ in length, but does not teach that each of the different length molecules may contain a different portion of a message. At column 6, lines 30-42, Bancroft teaches that a plurality of secret messages could be added to the same genomic DNA, but does not teach that each of a plurality of molecules each encoding different portions of the same message.

With particular respect to claims 23-25, 28 and 32, Applicants respectfully note that the prior art has **not** been applied against the subject matter of these claims. Indeed, all claims which recite a primer or primers that indicate the order of encrypted segments are novel and non-obvious over the cited art, as next discussed.

The presence of a continuation tail primer at the end of encrypted DNA segment indicates that there are more segments to be decrypted whereas the presence of a termination tail primer indicates the end of the segments.

Segmentation schematic is as shown below:



The process can better be understood by the following example:

Example: If a piece of information encrypted into DNA sequence is required to be segmented into 15 segments, then as per the scheme all these segments would at the start be attached with unique “header primers” divulging their respective segment number i.e. 1, 2, 3,...15 and at the end of first fourteenth segments “continuation tail primer’ would be attached. Fifteenth encrypted DNA segment would be attached with “termination tail primer”. During decryption, the segment having attached with a “termination tail primer” which will also divulge the last segment number i.e. the header primer attached will divulge the exact number of segments to be looked after for decryption and correct retrieval of the encrypted information.

Thus, by having two kinds of tail primers (continuation and termination) facilitates with error check and data integrity and this scheme is novel and non-obvious for DNA sequence segmentation.

In view of the above, Applicants respectfully submit that the prior art rejections and all other objections and rejections of record have been overcome and should be withdrawn. An early notice of allowance is earnestly solicited and is believed to be fully warranted.

Respectfully submitted,

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